BACTERIOLOGICAL WATER QUALITY OF STURGEON BAY AND STURGEON RIVER SIMCOE COUNTY

1974

Ministry of the Environment

Ontario

The Honourable
George A. Kerr, Q.C.,
Minister

Everett Biggs,
Deputy Minister

MINISTRY OF THE ENVIRONMENT

RECREATIONAL LAKES SELF-HELP PROGRAM.

BACTERIOLOGICAL WATER QUALITY

of

STURGEON BAY AND STURGEON RIVER

SIMCOE COUNTY

1974

by

George S. Hendry

and

Walter Falby

Bacteriology Section

LABORATORY BRANCH

STURGEON BAY

INTRODUCTION

The Recreational Lakes Self-Help program was established by the Ontario Water Resources Commission with interested cottager associations in 1971, and continued by the Ministry of the Environment since then to assist cottage owners to determine the bacteriological water quality of their lake. The Self-Help investigations can be useful in indicating possible contamination sources which require later M.O.E. surveys, or in assuring interested cottagers that the bacteria present are from natural sources without health hazards. The M.O.E. bacteriological survey is of special importance for typing and pinpointing bacterial pollution sources.

The success of this program depended on the enthusiastic support of the cottagers association, and especially Mr. Murray Rowan who took the samples and delivered them to the Ministry of the Environment Toronto laboratory for analysis.

Bacteriological Methods and Interpretation

Samples of lakewater were taken by recommended procedures (see Appendix A-5) regularly in July and August of 1974 at 18 selected sampling locations (see map).

The numbers of bacteria in each of three types of 'indicator' organisms were determined on each sample. The three bacterial types, total coliform, fecal coliform and fecal streptococcus (enterococcus) bacteria are all common to man and other warm blooded animals, and are found in the colon and feces in tremendous numbers. Many diseases common to man are transmitted by feces, consequently, the probability of occurrence of these diseases is usually highest in areas where the water is contaminated. These indicator organisms in water connote the possible presence of disease causing organisms (see Appendix, A-1).

The geometric mean,[1] the most appropriate representative value of the data for each station, was calculated, and evaluated with respect to the Ministry of the Environment Recreational Criteria,[1] which states:

> 'Where ingestion is probable, recreational waters can be considered impaired when the coliform (TC), fecal coliform (FC), and/or enterococcus (fecal streptococcus, FS) geometric mean density exceeds 1000, 100 and/or 20 per 100 ml respectively, in a series of at least ten samples per month, ...1

[1]Guidelines and Criteria for Water Quality Management in Ontario, M.O.E. 1974

A proper estimate of the bacterial population requires several measurements of bacterial density over a period of time which can then be averaged as a geometric mean. Therefore the sampling frequency in the Recreational Criteria is most important, and is usually achieved only with the M.O.E. and not the Self-Help surveys. The Self-Help program gives a good estimate of the bacteriological water quality of the lake. Single unconfirmed high values may indicate intermittant pollution, but must be interpreted cautiously.

The most important of the bacterial indicators of water quality is the fecal coliform density. These bacteria are largely Esherichia coli, an inhabitant of the intestines of man and animals. High levels of fecal coliforms without a corresponding level of fecal streptococcus may indicate some human contamination and an accompanying health hazard to users of the water.

Microbial contamination by raw or inadequately treated sewage does not significantly change the appearance of the water but poses an immediate public health hazard when the water is used for drinking or swimming. This type of pollution can be remedied by preventing wastes from reaching a lake. If this is the only source of pollution, satisfactory water quality will then return since disease causing bacteria do not usually persist in lake water.

Results & Discussion

The self-help sampling program showed that the bacteriological water quality of Sturgeon Bay in 1974 was good, however high levels of fecal bacteria were found in the Sturgeon River. The overall geometric mean densities for the entire survey period were 57 TC, 2 FC and 3 FS per 100 ml. Samples were collected regularly during July and August, which gave sufficient data for monthly mean bacterial levels to be calculated.

In July, the geometric means for the main body of water were 53 TC, 2 FC and 2 FS per 100 ml. High enterococcus levels of 78 FS per 100 ml were found at the mouth of Sturgeon River (Stn. 7) and further up its course (Stn. 6). Due to the high fecal streptococcus densities, another area, further up the river (Stn. 6A) was sampled once and bacterial counts of 264 TC, 1 FC and 24 FS per 100 ml were found. Sampling on a single day cannot give an accurate estimation of the bacterial population, but in this case a bacterial input was indicated. Higher bacterial levels have often been observed in inflows as they may carry various materials such as soil, decaying matter and possibly animal and human wastes.

In August, the bacterial densities for the bay area were 44 TC, 3 FC and 2 FS per 100 ml. The Sturgeon River

again had higher levels of fecal bacteria than did the bay itself. The river mouth area (Stn. 7) had a mean of 90 FS per 100 ml, and further upstream (Stn. 6) bacterial levels of 49 FC and 394 FS per 100 ml were found. Still further up the Sturgeon River (Stn. 6A), an enterococcus level of 89 FS per 100 ml was found. The Robins beach area (Stn. 12) also tended to have higher levels of fecal bacteria than did the rest of the bay but did not reach the high levels found in the Sturgeon River.

There were only slight differences in the numbers of bacteria in the bay area between July and August, and firm evidence of microbial inputs were found only in the Sturgeon River. However, it was not possible to assess the effect of these inputs on the bay itself since no data was available for the area in the immediate vicinity of the river mouth.

Sturgeon Bay was sampled by the Great Lakes Surveys, near the centre of the bay, in July 1974 and bacterial densities of 86 TC, 1 FC and 1 FS per 100 ml were found. These values indicated slightly better water quality than most shoreline locations.

It is likely that higher bacterial levels would be found during a full scale survey, and we recommend such a survey on the Sturgeon River and shore areas of the bay when possible.

TABLE I

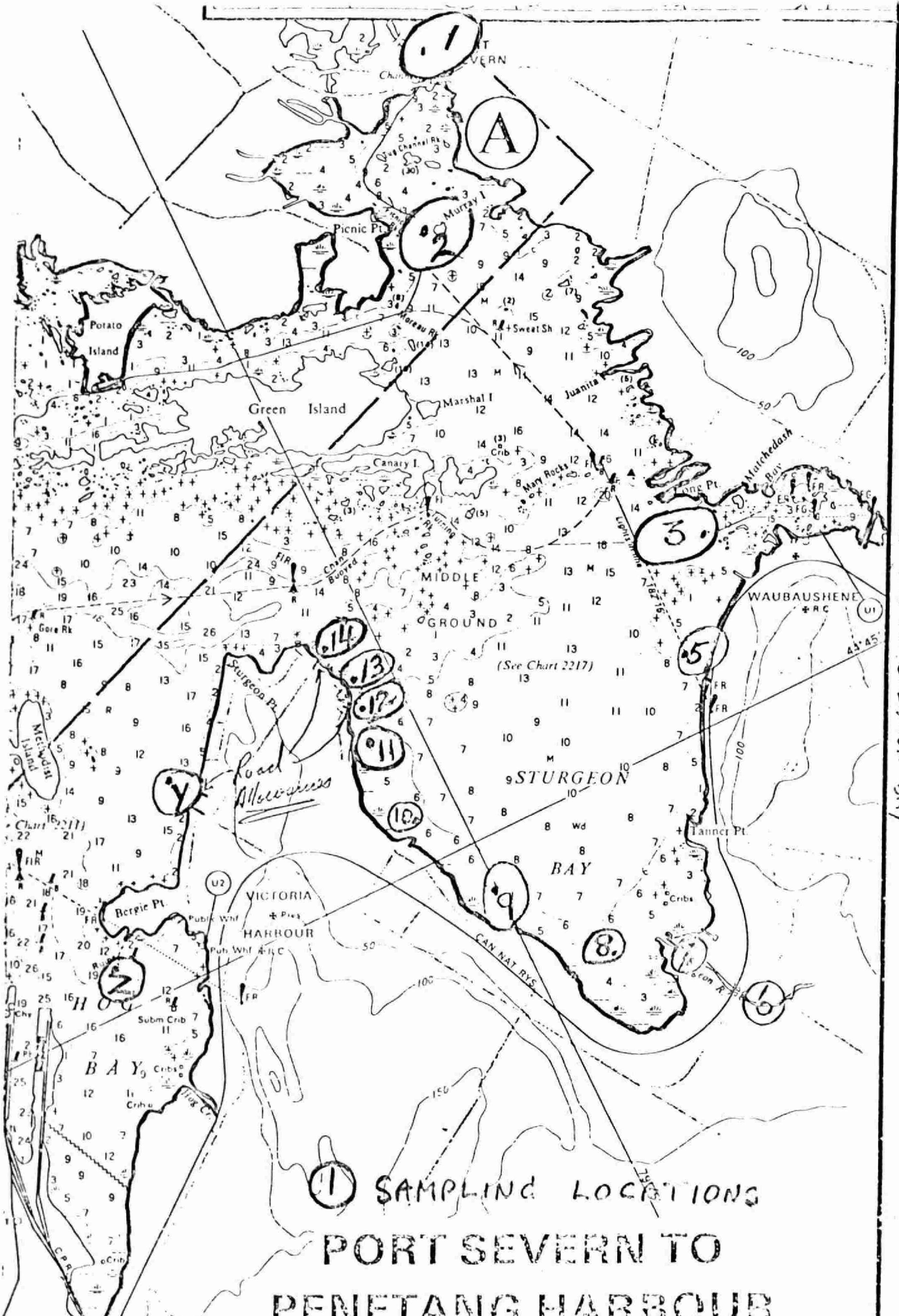
STURGEON BAY AREA 1974

STATION NUMBER	NO. OF PIECES OF DATA	GEOMETRIC MEAN BACTERIAL DENSITIES FOR ALL SURVEY DATA		
		TC/100 ml	FC/100 ml	FS/100 ml
1	6	71	3	1
1A	3	73	3	2
2	6	19	1	1
3	6	70	2	1
4	6	8	2	1
5	6	21	2	1
6	4	328	24	175
6A	3	323	4	57
7	6	240 (5)	10	84
8	6	59	1	2
9	6	45	2	4
10	6	20	2	2
11	6	21	1	2
12	6	13	4	8
13	6	55	4	4
14	6	36	1	7
Y	5	147	2	2
Z	5	146	1	2
Overall Geometric Means	(95)	57	2	3

TABLE II

STURGEON BAY AREA 1974

STATION NUMBER	MONTHLY GEOMETRIC MEAN BACTERIAL DENSITIES TC/100 ml JULY	TC/100 ml AUGUST	FC/100 ml JULY	FC/100 ml AUGUST	FS/100 ml JULY	FS/100 ml AUGUST
1	89	57	2	6	1	2
1A	20	138	1	4	1	4
2	12	28	1	2	1	2
3	105	46	1	3	1	1
4	16	43	2	3	1	1
5	124	36	1	4	1	1
6	470	233	11	49	78	394
6A	480	264	1	9	24	89
7	76	518	4	25	78	90
8	146	24	1	1	2	1
9	53	38	2	1	8	3
10	25	16	3	1	3	1
11	12	37	1	1	1	2
12	99	170	1	20	6	11
13	64	47	4	4	4	3
14	149	88	1	2	14	4
Y	261	100	3	1	1	2
Z	335	84	1	1	2	2



(1) SAMPLING LOCATIONS

PORT SEVERN TO PENETANG HARBOUR

SOUNDINGS IN FEET

APPENDIX

INFORMATION OF GENERAL INTEREST TO COTTAGERS
MICROBIOLOGY OF WATER

For the sake of simplicity, the microorganisms in water can be divided into two groups: the bacteria that thrive in the lake environment and make up the natural bacterial flora; and the disease causing microorganisms, called pathogens, that have acquired the capacity to infect human tissues.

The "pathogens" are generally introduced to the aquatic environment by raw or inadequately treated sewage, although a few are found naturally in the soil. The presence of these bacteria does not change the appearance of the water but poses an immediate public health hazard if the water is used for drinking or swimming. The health hazard does not necessarily mean that the water user will contract serious waterborn infections such as typhoid fever, polio or hepatitis, but he may catch less infections of gastroenteritis (sometimes called stomach flu), dysentery or diarrhea. Included in these minor afflictions are eye, ear and throat infections that swimmers encounter every year and the more insidious but seldom diagnosed, subclinical infections usually associated with several water born viruses. These viral infections leave a person feeling not well enough to enjoy holidaying although not bedridden. This type of microbial pollution can be remedied by preventing wastes from reaching the lake and subsequently water quality will return to satisfactory conditions within a relatively short time (approximately one year) since disease causing bacteria do not usually thrive in an aquatic environment.

The other bacteria live and thrive within the lake environment. These organisms are the instruments of biodegradation. All organic matter in the lake will be used as food by these organisms and will give rise, in turn to subsequent increases in their numbers. Organic matter from natural sources as well as that from sewage, kitchen wastes, oil and gasoline are readily attached by these lake bacteria. Unfortunately, biodegradation of large

quantities of organic wastes by organisms uses correspondingly large amounts of dissolved oxygen. If the organic matter content of the lake is high enough, these bacteria will deplete the dissolved oxygen supply in the bottom waters and so threaten the survival of many deep water fish species.

RAINFALL AND BACTERIA

The "Rainfall Effect" has been documented in previous surveys of Recreational Lakes. Heavy precipitation has been shown to flush the land area around the lake and the subsequent runoff will carry available contaminants including sewage organisms as well as natural soil bacteria with it into the water.

Total coliforms, fecal coliforms and fecal streptococci, as well as other bacteria and viruses which are found in human waste disposal systems, can be washed into the lake. This phenomenon is particularly evident in Precambrian areas where there is inadequate soil cover and in fractured limestone areas where fissures in the rocks provide access to the lake.

Melted snow provides the same transportation function for bacteria, especially in an agricultural area in winter where manure spreading is carried out on top of the snow.

Previous data from sampling points situated 50 to 100 feet from shore indicate that contamination from shore generally shows up within 12 to 48 hours after a heavy rainfall.

WATER TREATMENT

Lake and river water is open to contamination by man, animals and birds (all of which can be carriers of disease); consequently, NO SURFACE WATER MAY BE CONSIDERED SAFE FOR HUMAN CONSUMPTION without prior treatment, including disinfection. Disinfection is especially critical if coliforms have been shown to be present.

Disinfection can be achieved by:

(a) Boiling:
Boil the water for a minimum of five minutes to destroy the disease causing organisms.

(b) Chlorination Using a Household Bleach Containing 4 to 5.1/4% Available Chlorine:
Eight drops of a household bleach solution should be mixed with one gallon of water and allowed to stand for 15 minutes before drinking.

(c) Continuous Chlorination:
For continuous water disinfection, a small domestic hypochlorinator (sometimes coupled with activated charcoal filters) can be obtained from a local plumber or water equipment supplier.

(d) Well Water Treatment:
Well water can be disinfected using a household bleach (assuming strength at 5% available chlorine) if the depth of water and diameter of the well are known.

CHLORINE BLEACH
per 10 ft depth of water

Diameter of Well Casing in Inches	One to Ten Coliforms	More than Ten Coliforms
4	.5 oz.	1 oz.
6	1 oz.	2 oz.
8	2 oz.	4 oz.
12	4 oz.	8 oz.
16	7 oz.	14 oz.
20	11 oz.	22 oz.
24	16 oz.	31 oz.
30	25 oz.	49 oz.
36	35 oz.	70 oz.

Allow about six hours of contact time before using the water.

Another bacteriological sample should be taken after one week of use.

Water Sources (spring, lake, well, etc.) should be inspected for possible contamination routes (surface soil, runoff following rain and seepage from domestic waste disposal sites). Attempts at disirfecting the water alone without removing the source of contamination will not supply bacteriologically safe water on a continuing basis.

There are several types of low cost filters (ceramic, paper, carbon, diatomaceous earth sometimes impregnated with silver, etc.) that can be easily installed on taps or in water lines. These may be useful to remove particles if water is periodically turbid and are usually very successful. Filters, however, do not disinfect water but may reduce bacterial numbers. For safety, chlorination of filtered water is recommended.

SAMPLE-TAKING PROCEDURE

A maximum of 24 hours is permitted between time of sample collection and examination. The sampling bottle shall be kept unopened until the moment it is to be filled. After the bottle is screwed into place on the sample rod, the plastic covering is peeled off; the cap then is removed from the bottle using sterile technique. During sampling the cap and neck of the bottle should not be handled and should be protected from contamination. The bottle is then inverted and plunged into the water to a depth of about three feet. Enough air space should be left in the bottle to facilitate mixing of the sample by shaking before examination. Excess is poured off. The sample should be stored in an ice cooler immediately.

If the sample is being taken from a tap, the tap should be opened fully and the water allowed to run to waste for two or three minutes first. The flow from the tap should be restricted to one that will fill the bottle without splashing.

In collecting samples directly from a river, stream, lake, reservoir, spring or shallow well, the aim must be to obtain a sample that is representative of the water. From lakes, it is desirable to take samples 15 to 20 feet from shore and at a depth of three feet (1 meter) wherever

possible. In shallower water, sample at the mid depth. At the mouth of a stream, sample at the mid point of a line continuing the lake shore.

DATE DUE

	DATE DUE		